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ABSTRACT

This report begins with a rationale for organizing a mathematics methods course around a laboratory situation. The implementation of one such program is described in detail. Actual in-school work with elementary school children was an integral part of the program. Carefully selected undergraduate mathematics majors were found to be valuable assistants in the laboratory sessions. An evaluation and comments on areas of possible improvement follow. An appendix lists the materials used in the laboratory. (LS)

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FINAL REPORT TO THE ESSO EDUCATION FOUNDATION RE A SPUR GRANT

by

Virginia E. McGlone

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Title:

The Mathematics Laboratory: An Integral Part of the Pre-service Training of Elementary School Teachers

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June 23, 1972

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Current theories in the area of psychology of learning imply that actual manipulation of physical materials contributes to concept formation. An eminent proponent of this thesis is Jean Piaget, a developmental psychologist who examines in great detail the observed behavior of children in an attempt to reveal the order in which a human being becomes capable of performing different kinds of actions or operations and of apprehending structures of various complexity. He finds that a child passes through four distinct stages of growth. The first is a sensorimotor period of development from birth to eighteen months, wherein knowledge consists of the repertoire of responses which the infant has at his command to react to the objects he encounters. As language develops, the second stage is met; this pre-operational stage lasts from eighteen months to about six years. During this time the thought processes of the child are not reversible. He is able to fix his attention on only one aspect of a situation at a time and therefore can arrive at contradictory conclusions without being bothered at all. True operational thinking, which is logical and reversible, appears in the third stage, termed the concrete operational. It describes the time from six to eleven years when the child's thinking is bound to direct experience. When the child is able to think about the possible without reference to the actual, he has reached the fourth and final stage in Piaget's developmental theory, that of the formal operational period. Occurring as early as eleven or twelve, the child is now able to construct

theories and draw conclusions without appealing to empirical evidence.

The factors which influence transition from one stage of development to another include maturation of the nervous system which can open up possibilities for learning but is not sufficient to actualize the situation for learning. A second factor is experience with the physical world: learning from objects, as from examining relative weights of objects, or learning from actions on objects, as learning that two groups of three is the same as three groups of two. Social transmission, or the interaction of the child with other human beings and with the education process, is the third factor. The last, probably the most important in the theory of Piaget, is called equilibration. It integrates the effects of the other three factors, none of which is sufficient in itself to explain mental development. Equilibration refers to the child's self-regulatory processes; his attempts to structure his world and to introduce coherence and stability into it. The basis for learning is the child's interaction with his physical and social environment, leading to a continuous modification of his behavior patterns. Thus he passes from one stage to another.

While Piaget has not addressed himself specifically to the problems of education, nor to practical applications of his work, it should be clear that these ideas are relevant to educational practice. For one thing, the child's thought is

qualitatively different from the adult's. The educator must make a special effort to understand its unique properties in order to tailor the educational experience to the child's needs. Secondly, Piaget demonstrates that as soon as a child is born, he begins to develop patterns of growth based on physical experiences. He must look, touch and turn. He cannot learn by being told. Piaget has also shown that the child must be permitted to repeat the action over and over in order to reassure himself that what he has learned is really true. After a time, these actions are internalized in the form of thought. Still later, the child will be able to express on a verbal level the notions he has developed on the basis of interaction with the world.

From his work with young children in Australia and Canada, Zoltan Dienes has observed and formulated several principles which promote the learning of mathematics. He has observed that all abstraction springs from experience and that children think constructively long before they think logically. Therefore, with young children, it is necessary to devise situations which lead to constructive rather than analytic thinking. Many embodiments of a single concept must be provided in order that the common properties may be drawn out. Dienes has been remarkably productive in devising experiences in mathematics which are based on these first principles. His method of teaching mathematics utilizes individual instruction or small group work. He believes that children must be set free to make

their own discoveries and think for themselves. He emphasizes doing and constructing, noting that it is essential to understand that thinking time is not wasted time. His research (1960, 1963) provides evidence that learning can be achieved through active participation of the child. This conclusion can also be substantiated by the work of Jerome Bruner (1960, 1966) and Kenneth Lovell (1961).

While the idea of proceding from from the concrete to the abstract is not new in education, materials and methods of classroom organization founded on such a theory have only recently been devised and tested. Hollis (1965) compared the use of Cuisenaire materials with conventional materials with two groups of first and second graders. He found that the children using Cuisenaire materials learned the tradtional subject matter as well as the others and also acquired additional concepts and skills beyond those taught in the conventional program. Crowder (1966) reported that a group of first graders using Cuisenaire materials performed in a similar fashion when compared to a group of children taught in the usual manner. Earhart (1964) incorporated the abacus into the teaching of mathematics to first and third graders and found that the abacus group performed significantly better. Lucas (1967) studied the use of attribute blocks in first grade; children who were allowed to interact with these materials were better able to conserve cardinality and to conceptualize addition/sub-

traction relations than those taught without the use of these materials.

Studies by Greathouse (1963) and Miller (1957) found that classroom methods which emphasized meaning over drill computation were found to be most effective with respect to both skills and principles of mathematics. Shipp and Deer (1960), Shuster and Pigge (1965) and Zahn (1966) found that when more than fifty percent of the class time was spent in meaningful group activity, then achievement was higher. These reports are just a selection of the many experiments which have demonstrated the value of concrete materials and new methods of classroom organization in the learning of mathematics.

However, one thing is certainly apparent. Children can make discoveries only if the teacher is prepared to set up the real life situations which give rise to them. This implies that teachers must be aware of the mathematical ideas children should learn and the manner in which they do learn them. Realizing this, the Nuffield Mathematics Project in England has concentrated on publishing guides for teachers. Organized by Geoffrey Matthews in 1964, the aim of this project is to develop a contemporary approach to mathematics for children aged five to thirteen. They have attempted to do this by providing teachers with practical suggestions for class discussions and out-of-class activities, as well as situations which can be used to develop a mathematical sense. It is only through influencing the teaching staff that

meaningful changes in classroom objectives, atmosphere, and organization can be realized.

The theme of British training for elementary school teachers is that if teachers are to be convinced that children can learn mathematics through their own activity and discovery, then they must first experience discovery of mathematical concepts for themselves. Therefore British inservice workshops and courses for pre-service teachers strongly emphasize independent exploration and discovery. Detailed accounts are found in Mathematics in Primary Schools (1969), a publication of The Schools Council in England; they are also described by Edith Biggs (1968, 1969) of England.

In the United States, the value of mathematics laboratories for prospective elementary school teachers has been emphasized by many individuals. Arthur Morley worte in 1969 that, "laboratory type courses are much more successful for many prospective elementary school teachers. An important aim of this work is to give the student experience in using materials to set up problem situations." (Morley, 1969, p. 59). John Leblanc (1970) noted that the elementary school teacher should have the following competencies: know enough mathematics to be able to make decisions on programs and organization intelligently, know enough about learning to select and design appropriate activities, and know what materials are available and how to use them in mathematics laboratories. He concluded, "It is just as

appropriate to have a math lab center for preparing teachers as it is to have a lab for science methods." (Leblanc, 1970, p.607) In August 1967, thirty five professors of mathematics met in conference at Michigan State University for two weeks. They concluded that implementation of contemporary programs depends to a large extent upon the understanding of teachers. What they need is a blending of content, current knowledge of psychology of mathematics, and educational methods into a viable program. (Houston, 1968) It is our feeling at the College of Saint Elizabeth that a mathematics laboratory for prospective elementary school teachers can be the way to produce such a blend.

The use of laboratory situations in the training of elementary school teachers in the United States is limited. Clarkson (1970) described a math lab approach used at the State University College at New Paltz which incorporated content, methodology, and practical experience with children. During this one semester course, children from four area schools were brought to the campus. Each child and each college student had the opportunity to participate in five to ten laboratory sessions during the semester. We feel that the project at the College of Saint Elizabeth, while similar to Clarkson's, has the added advantage of being a two semester course, with four credits in each semester. Each preservice college student participates in at least thirteen laboratory sessions each semester and thus has the opportunity to learn to use many different kinds of materials

before going to do practice work with children at a nearby elementary school.

According to Fitzgerald (1968), students at Michigan State University attended large lecture sessions three days per week and a two hour lab once a week. During the lab, thirty students, under the direction of a graduate student, worked in groups of one to five in activity-centered learning situations. However, the experiment in Michigan did not involve interaction with elementary school children. We feel that this aspect of our project is reminiscent of the campus school, which often provides the large university with a teaching laboratory.

Several descriptions of the math lab approach to the teaching of mathematics for the elementary school teacher can be found in a recent ERIC publication compiled for the Forum on Teacher Education, National Council of Teachers of Mathematics. Hooten (Forum on Teacher Education, 1972, p. 70) described the place of the laboratory in a methods course at the University of Georgia. The course included a laboratory of one and a half hour's duration which was used to give the student experience in personal discovery and to provide the opportunity of assembling a notebook of about one hundred tested classroom activities.

Research conducted at the University of Northern Iowa compared two approaches to teaching an elementary methods course. As described by Wilkinson (Forum on Teacher Education, 1972, p. 74), twenty laboratory activities were incorporated into the course.

In treatment I, the teacher demonstrated the activities, while in the second treatment the students did the experiments and completed worksheets as an out of class activity. Analysis of covariance did not indicate a significant difference between the two treatments with respect to attitudes toward mathematics and mathematics laboratories. However, there was an apparent trend toward the second treatment's producing more favorable attitudes.

Working on the assumption that teachers tend to teach as they are taught, LeBlanc (Forum on Teacher Education, 1972, p. 39) of Indiana University reported that in the fall of 1972, two pilot classes involving fifty students will be conducted with a new approach. Faculty members will utilize the techniques and strategies which the student should use in his own classroom. Mathematics will be learned by doing, using activity cards and peer teaching. At times, the pre-service teachers will observe in a model school which is part of the project, and even teach mini-lessons to the youngsters in this school. The goal of the project is to extend it to all sections of the course as soon as feasible.

The present project at the College of Saint Elizabeth aims to improve the effectiveness of the mathematics training of future elementary school teachers by a) strengthening their mathematical competence with two courses, Fundamental Concepts I, II, which follow the guidelines established by the Committee on the Undergraduate Program in Mathematics of the Mathematical

Association of America, b) providing a mathematics laboratory setting to give them the chance to experience mathematical discovery for themselves, c) showing them what laboratory materials are available and how they can be translated into teacher-made or student-made versions, and d) providing the opportunity to work with children individually or in small groups in a laboratory setting.

A mathematics laboratory is a planned environment where students attempt to solve problems through concrete experiences. The physical facilities may range from a corner table in the traditional classroom to an elaborate learning center equipped with the latest teaching devices. Whether the materials available are home-made or precision-made is not of primary importance. The important thing is the atmosphere created by the teacher. The child must be encouraged to explore and discover, to solve problems through concrete experiences with a minimum of teacher interference. Materials provided should include such things as sand, water, clay, pebbles, graduated containers, cylinders, cones, blocks, felt pens, chalk, paper, rulers, thermometers, compasses, multibase blocks, unifix cubes, abaci, geoboards, clocks, scales, plastic shapes, etc. Each child is urged to do his best in finding solutions to various problems. In this way, the mathematics laboratory provides one possible answer to the problem of individualizing instruction. We maintain it should be part of the pre-service training of elementary school teachers. How else

can they be expected to understand the format, utilize the materials and provide the appropriate atmosphere when in their own classrooms with thirty children.

Prior to the academic year 1971-72, during each semester of the junior year, prospective elementary school teachers at the College of Saint Elizabeth took a three semester hour mathematics course taught by a member of the Mathematics Department and a one semester hour methods course in the Education Department. Supported by a SPUR Grant from the Esso Education Foundation, these four courses are now integrated into two courses, Fundamental Concepts of Mathematics I and II, each carrying four semester hours of mathematics credit. Approximately forty students each year register for this sequence; they are divided into two sections. Each section meets for three one hour classes and a two hour laboratory each week. All classes meet in the room where the laboratory materials are available so that the use of the materials is not confined to the lab period. A list of the materials now available in the College's math lab can be found in Appendix I.

The academic year 1971-72 was the first year of operation of the project. During the first semester, the three one hour lectures were used to develop the mathematical concepts necessary for elementary school teachers. The laboratory periods provided an extended time in which concepts could be strengthened by the use of concrete materials. Table 1 illustrates the

coordination between the material of the text (Wheeler, 1970) and the activities of the lab. The first column records the topic being covered from the text; the second column records the materials used during the lab period of that week, while the last column gives the source of the activities. Occasionally, students worked through the problem cards associated with the concrete materials. Various publications of Zoltan Dienes were used. Dittoed lab sheets of activities devised by the staff were also distributed. Sometimes an appropriate experiment was selected from the Laboratory Manual for Elementary Mathematics (Fitzgerald et al, 1969) which each group of four students had purchased. Each student kept a log book of the lab sessions which was used for discussion and evaluation.

During November, 1971, each pre-service teacher prepared several lesson plans for use with elementary school children. These were submitted to the instructor, criticized, amended and revised, if necessary. They included activities using creature cards, people pieces, base 10 and base 2 arithmetic blocks, cuisenaire rods, as well as rotating and flipping games described by Dienes and Golding (1966). Then each section made two visits to Assumption elementary school in nearby Morristown, New Jersey where each pre-service teacher executed her lesson plans with three or four youngsters.

Additionally, in the first semester, each pair of pre-service teachers was required to design and execute a mathe-

TABLE 1

COORDINATION OF MATHEMATICAL CONCEPTS WITH MATH LABS

TOPIC	MATERIALS	SOURCE OF ACTIVITIES
logic	attribute blocks, people pieces, creature cards, logical blocks	problem cards
union and intersection of sets	as above	activities from Dienes' Learning Logic, Logical Games
relations	cuisenaire rods	lab #3, Relations, Fitzgerald et al(1969(
system of whole numbers	cuisenaire rods	cuisenaire activity cards, lab #5, Whole and Rational Numbers, Fitzgerald et al(1969)
system of whole numbers	cuisenaire rods, paper clocks, squares, and triangles	lab #9 Mathematical Systems Fitzgerald et al(1969)
numeration systems	as above	continuation of Mathematical Systems
number bases	Dienes' multi-base arithmetic system	ditto sheets from instructor
algorithms	lattice multiplication, napiers bones, slide rules	instructor and lab assistants
nonmetric geometry	geoboards	properties of geometric figures using problem cards
metric geometry	geoboards, compass, straight edge	area, perimeter, geometric constructions, dittoed by instructor
metric geometry		geometric transformations of translation, rotation, and reflection, dittoed by instructor

matics bulletin board, a game, or a concrete teaching aide suitable for elementary school mathematics. Bulletin boards on sets, the number line, the Egyptian and Mayan number systems, and fractions were mounted in the math lab. Peg boards, fraction games, a large circle geoboard, and number base games were contributed to the lab.

During the second semester, the mathematics topics included a brief review of the system of whole numbers, followed by the study of the integers, elementary number theory, rational numbers, and real numbers. As needed, the equipment of the College's math lab was transferred to Assumption elementary school; each section met there for nine laboratory periods, working with the first four grades. During the lab session, each college student spent forty-five minutes with a small group of children. The pre-service teachers prepared activities in measurement which included estimation, comparisons, non-standard units, and standard units in relation to length, weight, liquid measure, and time. After four weeks, the groups were changed. Subsequent activities in geometry included classifying, identifying, and naming geometric shapes, symmetry, studying the properties of figures, perimeter, area, and volume. Each week, after the youngsters left the lab area, the college students discussed objectives, outcomes, and problems encountered. Each student also kept a written record of each session in a log book. These log books were part of the evaluation of work done during the course. They

were returned to the college students since they should be very useful to them in student teaching.

During this semester, lab sessions were periodically held at the College, giving the college students time to prepare their lessons, examine other concrete materials, and trade ideas. They also filled out a student development appraisal (Biggs, 1969, p. 193) for each youngster with whom they worked in the lab. Since each child had worked with two college students in the course of the semester, he had been evaluated twice. These evaluations were compared and discussed by the college students during the final class of the semester.

In March, 1972, a member of the Education Department of the College of Saint Elizabeth met with the students and staff to discuss problems which arose in working with the children, and to help them evaluate their effectiveness. This proved valuable in that each college student saw that others in the class had experienced some difficulty in handling certain children. Various supportive units in the educational system were discussed as well as the symptoms which might prompt referral. Most of all, the students received assurances that they were doing all that could be expected. This provided a psychological lift to those who wanted some sort of tangible evidence of success.

The materials which are presently in the math lab collection at the College of Saint Elizabeth are listed in Appendix I. Chosen to be representative of the areas of

numeration, measurement, geometry, and teacher resource materials, they are an invaluable addition to this project. Books by Dienes and a collection of Nuffield Foundation guides are available in the lab, as well as numerous descriptions of teaching aides and activities. Issues of The Arithmetic Teacher for the past three years are part of the collection. Of course, the complete set of this periodical is available in the library, as well as an excellent collection of mathematics and education books. With all of this material available, the pre-service teachers involved in this project were able to learn to use the commercially produced concrete materials, and to translate them into teacher-made versions.

The reorganization of the course Fundamental Concepts I and II for the training of elementary school teachers was originated by Virginia McGlone and Sister Gabriel Mary Donahue, S.C., members of the Mathematics Department of the College of Saint Elizabeth. Sister Gabriel Mary was originally project director. However, as the final proposal for the SPUR Grant from the Esso Education Foundation was being written, Sister Gabriel Mary was awarded a TTT fellowship for doctoral study in the Department of Mathematics Education at New York University. Dr. Morrison, Chairman of the Mathematics Department, assumed the position of project director.

Dr. Barbara A. Morrison received the Ph.D. in Applied Mathematics in 1956 from Brown University. She has been a full

time faculty member at the College of Saint Elizabeth since 1964 and is at present Chairman of the Mathematics Department and Associate Professor of Mathematics. She served as a member of the Edwin Aldrin Fund Advisory Panel for the academic years 1970-71 and 1971-72. She was a Director of an NSF Summer Institute in 1971. As project director of the SPUR Grant, she was responsible for policy decisions and the administration of funds.

Mrs. Virginia McGlone was a member of the staff of the SPUR Grant. She received the M.A. degree in mathematics from Fordham University in 1963. She is a candidate for the Ed.D. in college teaching of mathematics from Teachers College, Columbia University. From September, 1965 to January, 1972, she was a Lecturer in the Department of Mathematics at the College of Saint Elizabeth. In January, 1972, she was appointed Assistant Professor in the same department. She taught one section of Fundamental Concepts I and II; she selected and ordered the materials, chose the lab assistants, and served as coordinator with Assumption elementary school.

Sister Anita Sibilia, M.P.F. taught the second section of Fundamental Concepts of Mathematics. She received the degree of Doctor of Education in Mathematics from Pennsylvania State University in 1967. Having experience in teaching elementary and high school mathematics, she was involved in the teacher training program in elementary school mathematics at Villa Walsh College in Morristown, New Jersey; she was also Dean of that College.

During 1971-72, Sister Anita held the position of Lecturer in the Departments of Mathematics and Education at the College of Saint Elizabeth.

Three laboratory assistants, undergraduate mathematics majors with an interest in education, worked with the pre-service teachers under the direction of the instructor. The instructor and at least one assistant were present at each lab session during the first semester. Unfortunately, in the second semester, conflict between the hours of mathematics courses and one lab period made it impossible to have a lab assistant present in that section. The assistants helped in preparation of materials and were responsible for storage and upkeep of equipment. Their diligence, combined with a very mature attitude toward the materials on the part of the pre-service teachers, resulted in almost no loss or damage to the equipment. A few thermometers, a three minute timer, and some primary scissors, all inexpensive items, were the only casualties, In addition, assistants carefully examined homework assignments and during convenient, specified hours one assistant was available for individual or small group instruction in mathematics. It is the feeling of the staff that this aspect of the project had a very definite beneficial effect on the learning of the mathematics component of the course. Therefore the use of assistants will remain a part of this course in the future.

At the College of Saint Elizabeth, the classes are held in a modern classroom furnished with individual chairs and tables

instead of the usual lecture chairs. Located in the new library building with reference materials easily available, there is ample storage space for the concrete materials involved. At Assumption elementary school, the sessions are held mainly in the cafeteria, with a few groups in the adjacent gymnasium. Both are bright and spacious rooms. There is an abundance of chairs and tables which can be easily moved and rearranged to suit the activity. Here too, in a nearby storage room, there are several closets for storage of the equipment.

When consideration was given to evaluation of the project, the typical research paradigm of two randomly established groups with one group receiving the proposed math lab treatment and the other serving as a control group was deemed inappropriate in this situation. It would seem that the main dependent variable would be the effectiveness of the student when she is teaching mathematics to her own class in the elementary school, and this would be impossible to measure. We, therefore, proposed an outside, independent evaluator who would examine the organization of the mathematics laboratory at the College and at Assumption School. Dr. Donald Herdman, Dean of the School of Education of Fairleigh Dickinson University in Rutherford, New Jersey agreed to take the assignment. He has been very thorough in his investigation, visiting the project at least ten times; he conducted interviews with the pre-service teachers, members of the staff, chairmen of the Mathematics and Education Departments, as well as

with the children, teachers and principal of Assumption elementary school. The report of his observations and recommendations along with the following comments from all sectors involved in the project will constitute the evaluation.

Response to the project has been positive and enthusiastic on the college level and on the elementary school level. In a written evaluation of the course submitted by each pre-service teacher, everyone considered it a valuable experience, worth repeating for next year's juniors. They reacted favorably to the wide variety of concrete materials available. They discovered for themselves how much planning is involved. But they were rewarded by the obvious willingness to learn and enthusiasm on the part of the youngsters. Sister Rosemary McNabb, principal of Assumption elementary school, reported that the project was a very valuable addition to the curriculum. She said that a number of parents had also expressed their satisfaction with the math lab and the hope that we would continue next year. Neither was the staff of the project disenchanted by the experience of the academic year 1971-72. In fact, they are more convinced than ever of the value of a math lab in conjunction with the mathematics course for elementary school teachers. The staff felt that there was a positive shift in attitude toward mathematics and the teaching of mathematics on the part of the pre-service teachers, but there was no provision for documentation of this change. Because of this support by the staff, the college

students, the elementary school youngsters, their principal, and their parents, the College of Saint Elizabeth and the staff of the project has decided to continue it during the academic year 1972-73.

Of course, some areas in need of improvement were discovered. Several comments made in the evaluations will be incorporated next year. For example, one lab section experienced difficulty with too many people wanting to use the same material during the same lab. Their suggestion of posting a list will certainly lessen this problem. On the other hand, the members of the other lab were able to handle the decisions of who would use the various items by informal contacts outside of class. However, this second lab section was dissatisfied with the noise level when all the youngsters were in the cafeteria. Yet, few of them wanted to work in the gymnasium. Next year, the staff will look for alternative areas in which to work and will also be more firm in spreading out the groups. Many of the pre-service teachers expressed the desire to have more contacts with the classroom teachers of Assumption School. This is another area on which the staff will be working. In all, the staff of the project felt that the college students gave a sincere evaluation. While their overall view of the project was very favorable, their comments and suggestions were sound and will be seriously considered.

The thrust of the program called Support for Promoting the Utilization of Resources (SPUR) of the Esso Education

Foundation is to improve instruction, administration, and physical resources of colleges and universities. This aim has certainly been achieved at the College of Saint Elizabeth in the area of instruction, which includes methodology and the curriculum. The SPUR Grant has provided a genuine innovation at the College of Saint Elizabeth and in higher education in general. The College has benefited by the introduction of a new course which will remain in the sequence required by majors in Elementary Education. The students have benefited by being introduced to many concrete materials and a new method of teaching and having the opportunity to use them in teaching mathematics to youngsters. Additionally, the SPUR Grant has provided the materials which enable members of the College faculty to contribute their knowledge and experience to workshops for local elementary school teachers. This was done once this year as a service to the community and requests for next year are already being received. The materials will also be used in the 1972 summer session in conjunction with an Education course in individualized instruction. Hopefully, these introductions to math lab materials and activities made possible by the Esso Education Foundation will encourage teachers and prospective teachers to reorganize mathematics classes. This is the ultimate aim of the mathematics laboratory project at the College of Saint Elizabeth.

BUDGET

	Contribution of SPUR Grant		Contribution of College
a. Staff	$ 2790.00	Staff	$2310.00
b. Equipment	500.00	Equipment	300.00
c. Transportation	96.00		
d. Evaluation	500.00		
e. Preparation of report	200.00		
Total	$ 4086.00	Total	$2610.00

BUDGET DETAILS	Budget	Actual
a. Instructor's salary for one section computed at the rate of $275.00 per semester hour of credit for eight credits	$2200.00	$2200.00
F.I.C.A. at 5%	110.00	110.00
Two undergraduate assistant's salaries computed at the rate of $2.00 per hour for four hours a week for thirty weeks	480.00	321.64
College's contribution: one instructor's salary computed as above	2200.00	2200.00
F.I.C.A. at 5%	110.00	110.00
b. Laboratory materials, equipment and supplies as described in Appendix I	500.00	500.00
College's contribution: Laboratory materials	300.00	300.00
c. Transportation computed at 10¢ a mile for eight weekly trips of 6 miles each for twenty weeks. Payment will be made to students whose cars are used. (11 drivers for eleven weeks were paid.)	96.00	72.60

BUDGET

d. Fee for outside evaluator is computed at estimated rate of $100.00 per day for a maximum of five days	$ 500.00	$ 500.00*
e. Secretarial assistance for one week at rate of $2.50 per hour	100.00	40.00*
F.I.C.A. at 5%	5.00	2.00*
Stationery and supplies	95.00	20.00*
Total	$ 6696.00	$ 6376.24
College's contribution	- 2610.00	-2610.00
Esso Foundation Funds:	$ 4086.00	$ 3766.24

Grant and Expenditure Totals:	
Granted by Esso Foundation	$ 4086.00
Total Expenditures	3766.24
Unexpended Balance	$ 319.76

The services of the Director and the Consultants from the Education Department were contributed.

* Estimated, to be paid in July, 1972.

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APPENDIX I

New Acquisitions for Math Lab During 1971-72

Geo Blocks with Guide	Selective Educational Equip.
Set of three large hoops (2)	"
Geometric Shape Spotting	"
Spot the Set	"
Symmetry Patterns	"
Fraction board	"
Yard rule with four faces - Primary	"
Yard trundle wheel	"
Thermometers (5)	"
Equal pan balance and balance book	"
Set of nine weights	"
Time teller clock	"
Shape construction set (on order)	"
Primary ruler	"
Competitive fractions	"
Plastic chips for counters	"
Dice	"
Three minute timers (2)	"
Primary rulers (12)	"
Primary yardsticks (2)	"
Pegboard and pegs	"
Supplementary boxes of rods (2)	Cuisenaire Co. of America
Student activity cards for rods (2)	"
Geoboard activity card kit	"
Think-a-dot	"
Open Doors - pupil and teacher editions, one copy each	"
Mathematical Awareness by Trivett (2)	"
Centimeter graph paper	"
Multibase arithmetic system	Herder and Herder
Base 10 arithmetic blocks	"
Exploration of Space by Dienes (2)	"
Learning Logic, Logical Games by Dienes (2)	"
Logical blocks - classroom set	"
Crayons (15 boxes)	Milton Bradley - W. J. Linn
Clay (5 lb.)	"
Flan-o-graph	"
Flannel board cut outs	"
Bulls eye paper 12x18 (10 pkgs.)	"
" " " 18x24 (5 pkgs.)	"
Materials for mirror cards and teachers guide	McGraw-Hill Book Co.

LaPine Sage kit of solids	LaPine Scientific Co.
Using Tile abacus by Sealy	Math Media, Inc.
Map measures and compass (3)	"
Set of geometric figures	"
Binary teacher	"
Tower puzzle	"
Mathematical balance work cards	"
Numble	"
Scan	"
Kalah	"
Yahtzee	"
Tangram Puzzles	"
Pan Balance Scale	"
Time Learner (1 doz.)	"
Shape Analysis Matching Game	"
Large Caliper	"
Probability kit	Math-Master

scissors, stapler, index cards, rulers, yardsticks, cups, pints, quarts, gallon, pencils, stirrers, clothespins, tape measures, string, rice, nails, beans, scotch tape, graph paper of various grid sizes, white paper, construction paper of several sizes in assorted colors

Math Lab Materials Purchased Previous to Esso Grant

Cuisenaire rods
Logical blocks - small set
Algebraic Experience Materials
Unifix introductory kit
Mathematical balance
Attriblocs
Primary tile abacus
Twenty geoboards
Tangram puzzles
Multi-base converter
Madison Project independent exploration material
Action Fractions (three variations)
Fraction board
Number lines
Attribute games and problems (A blocks, color cubes, people pieces, and creature cards)
Soma cubes
Wff-n-Proof
Lego Educational Gear Set
protractors, compasses
slide rules
graph paper
collection of cards, chips, shells, etc. for sorting and classifying